First approach to study the size and morphology of gorgonian corals and sponges using photogrammetric analysis from video transects in the Marine Protected Area 'El Cachucho' (Cantabrian Sea).

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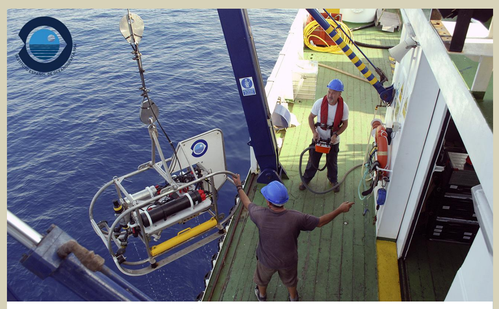
This study presents methodology and first results obtained in the analysis of the video transects acquired in 'El Cachucho' MPA, during the ESMAREC survey using the ROTV *Politolana* underwater towed vehicle. Video was recorded to pilot the ROTV, so characteristics of video camera were not specifically designed for monitoring the habitats. But recent developments in specific software of photogrammetric image analysis have allowed extracting valuable information of these video transects. This methodology is particularly valuable in the study of vulnerable ecosystems

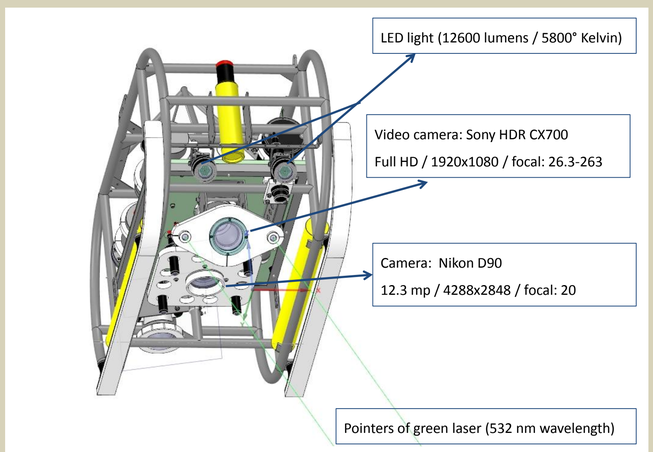
DATA ACQUISITION



Oceanographic survey ESMAREC (2015)

The video transects analyzed in this study were acquired in 'El Cachucho' Marine Protected Area, during the ESMAREC survey using the ROTV *Politolana* underwater towed vehicle. Politolana sled, designed by the Santander IEO is a robust submarine towed vehicle to study the deep-sea floor.

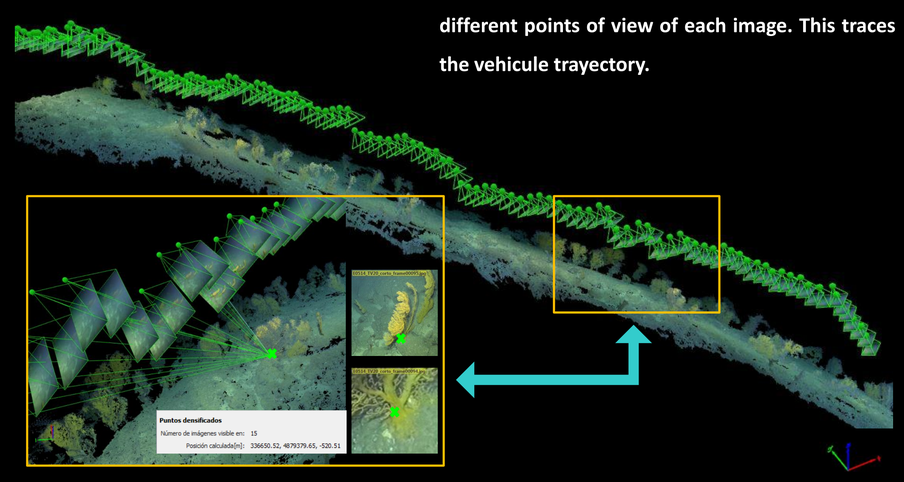
The vehicle can be operated up to a maximum of 2000 m depth and the transects were carried out navigating to 1 knot of speed at an altitude between 2-4 m over the sea floor. The sled has bidirectional telemetry to control the submerged instruments (altimeter, CTD probe, compass, video and still cameras control, etc.) and sends the data to surface correctly synchronized in real time. This vehicle acquires simultaneously still pictures and video, georeferenced and synchronized with environmental variables. To pilot the ROTV it uses a FullHD video camera, installed with an angle of 45° with respect to the bottom, and two LED last generation light (12600 lumens / 5800° Kelvin).



ROTV *Politolana* underwater towed vehicle

METHODOLOGY

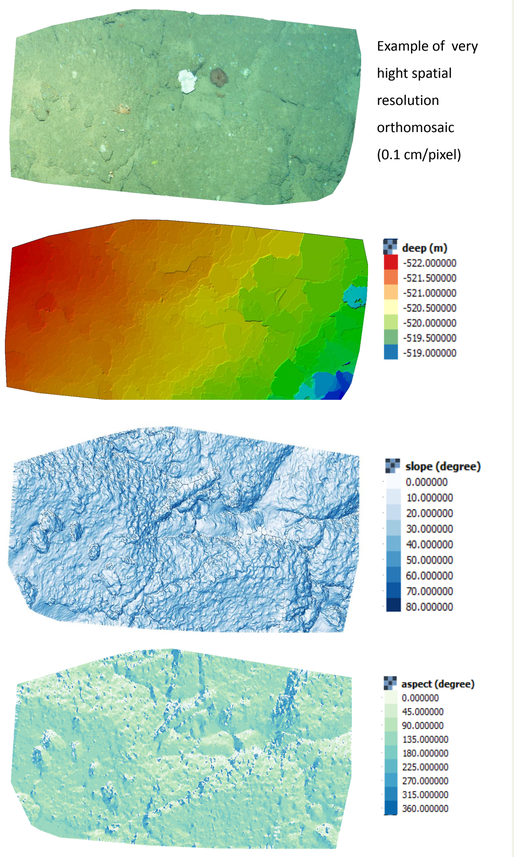
Video-sections were decomposed in many of overlapping images and processed with a comercial photogrammetry software Pix4Dmapper Pro. The software carries out an advanced automatic triangulation based purely on image content and an optimization techniques. The triangulation algorithm is based on binary local keypoint, searching for matching points by analizing all images. Those matching points as well as approximate values of image position and orientation provided by Politolana telemetry system are used in a bundle adjustment to reconstruct the exact position and orientation of the camera for every acquired image.



Reconstruction of a video-transect frames over gorgonian forests. In green we can see the different points of view of each image. This traces the vehicule trayectory.

Based on this reconstruction the matching points are verified and their 3D coordinates calculated. This approach doesn't take into account the additional optical elements for housed cameras (flat port) and the software consider the system like a unique optical element.

CARTOGRAPHIC PRODUCTS



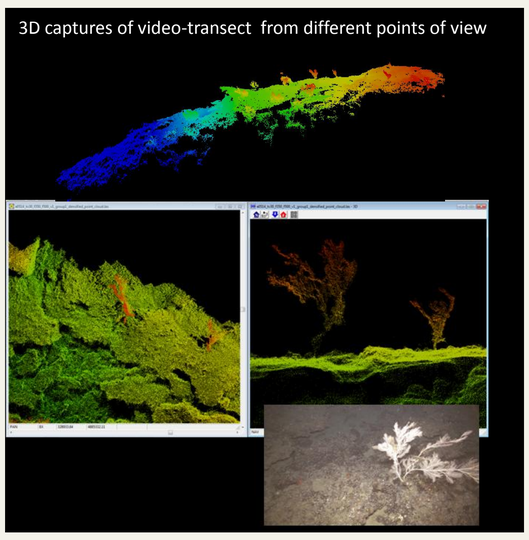
The outputs available from this approach are geo-referenced and high spatial resolution 2D mosaics, 3D surface models and point clouds.

Products derived from sea floor morphology like maps of slope, aspect, rugosity, curvature, etc. can be extracted from Digital Surface Model (DSM) in a simple way.

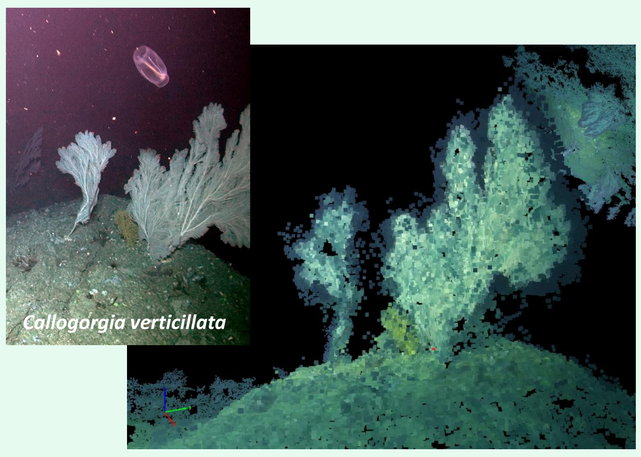
All the geographic layers can be included in a GIS environment because all the information are geo-referenced in a cartographic system (UTM-WGS84)

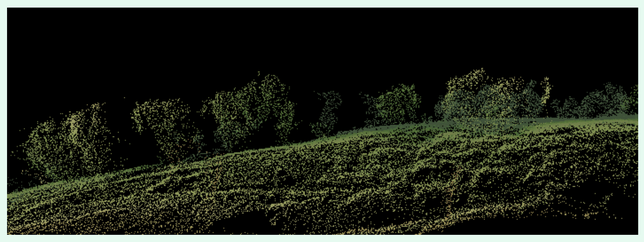
To avoid the lack of calibration of the camera the laser beam projected over the seafloor have been used to scale the photogrammetry block. But to work with these photogrammetric techniques a specific calibration exercise of the cameras is necessary.

The 3D point cloud is a cartographic product that contains coordinates (XYZ) of the points and color information. This valuable information allows height and morphology analysis. The files are similar to LiDAR data (LAS file) and can be processed with Lidar tools, like LASTools, Fusion or FUGROViewer.



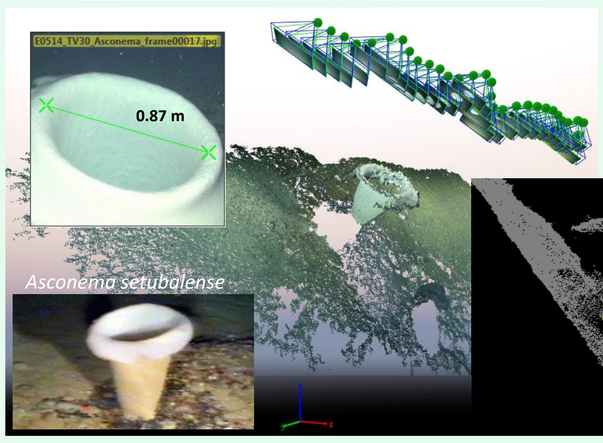
SIZE AND MORPHOLOGY OF CORALS AND SPONGES





In a first approach it has been studied the size and morphology of gorgonian corals and sponges using photogrammetric analysis. These examples have been recorded in depths from 500 to 600 meters.

Figures show the 3D reconstruction of video transects frames over gorgonians (*Callogorgia verticillata* and *Paramuricea* cf. *placomus*) and sponges (*Asconema setubalense* and *Geodia megastrella*). In green we can see the different points of view of each image. The point cloud allows size, morphology and volumetric measurements.



Future applications:

- Morphology study of epibenthic fauna and their relationship with the environmental variables.
- Monitoring the effects of MPA management measures on vulnerable species (coral-reefs growth, density, etc.).